SIDANG TERTUTUP

TESIS – SM142501

STRUKTUR HIRARKIS JALUR KERETA API SEMI-DOUBLE TRACK MENGGUNAKAN PETRI NET DAN ALJABAR MAX-PLUS

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Tri Utomo (1213 201 015)

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Dr. Subiono, M.S.

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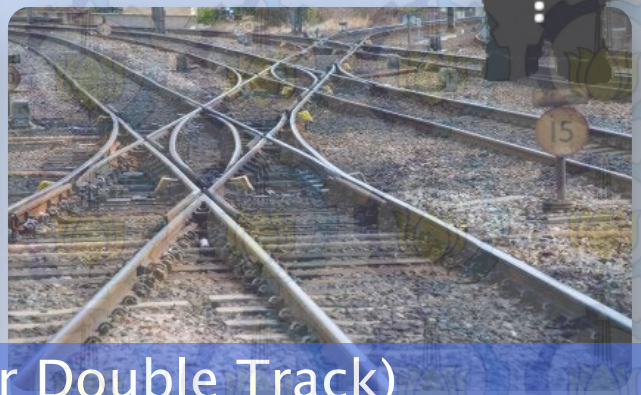
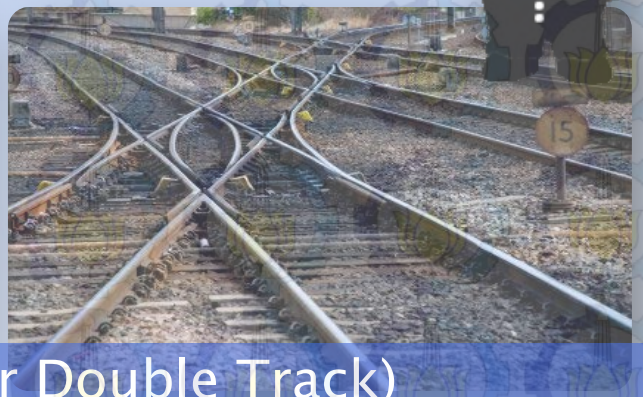
Pengalihan Transportasi dari Mobil Ke Kereta Api

SOLUSI PERMASALAHAN

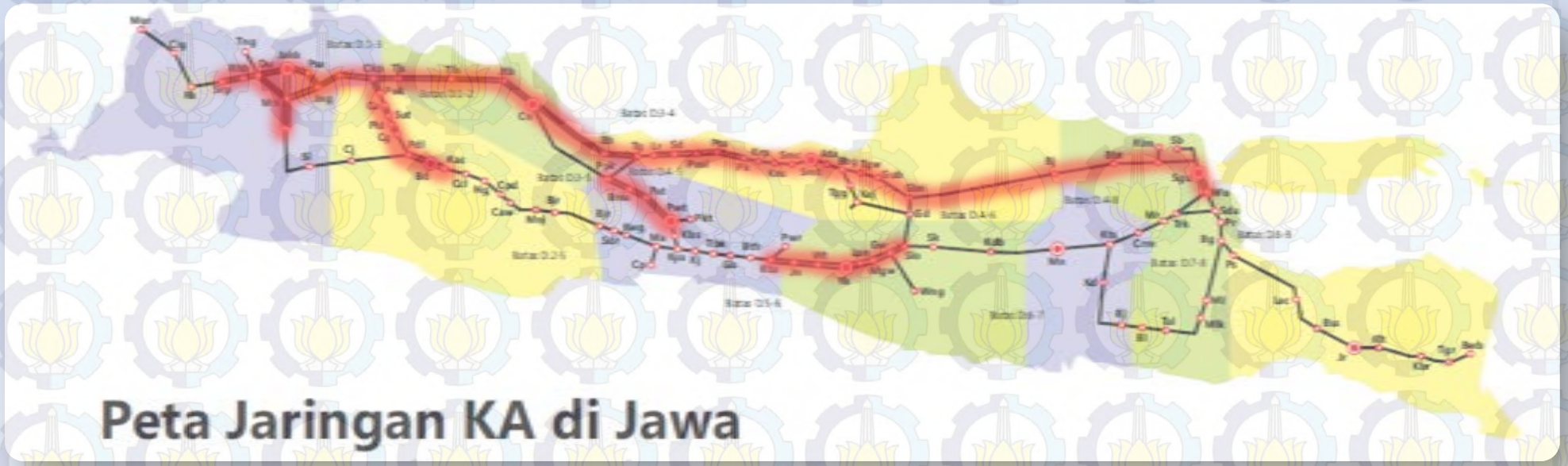


Kebijakan Pemerintah (Pembangunan Jalur Double Track)

SOLUSI PERMASALAHAN



Kebijakan Pemerintah (Pembangunan Jalur Double Track)



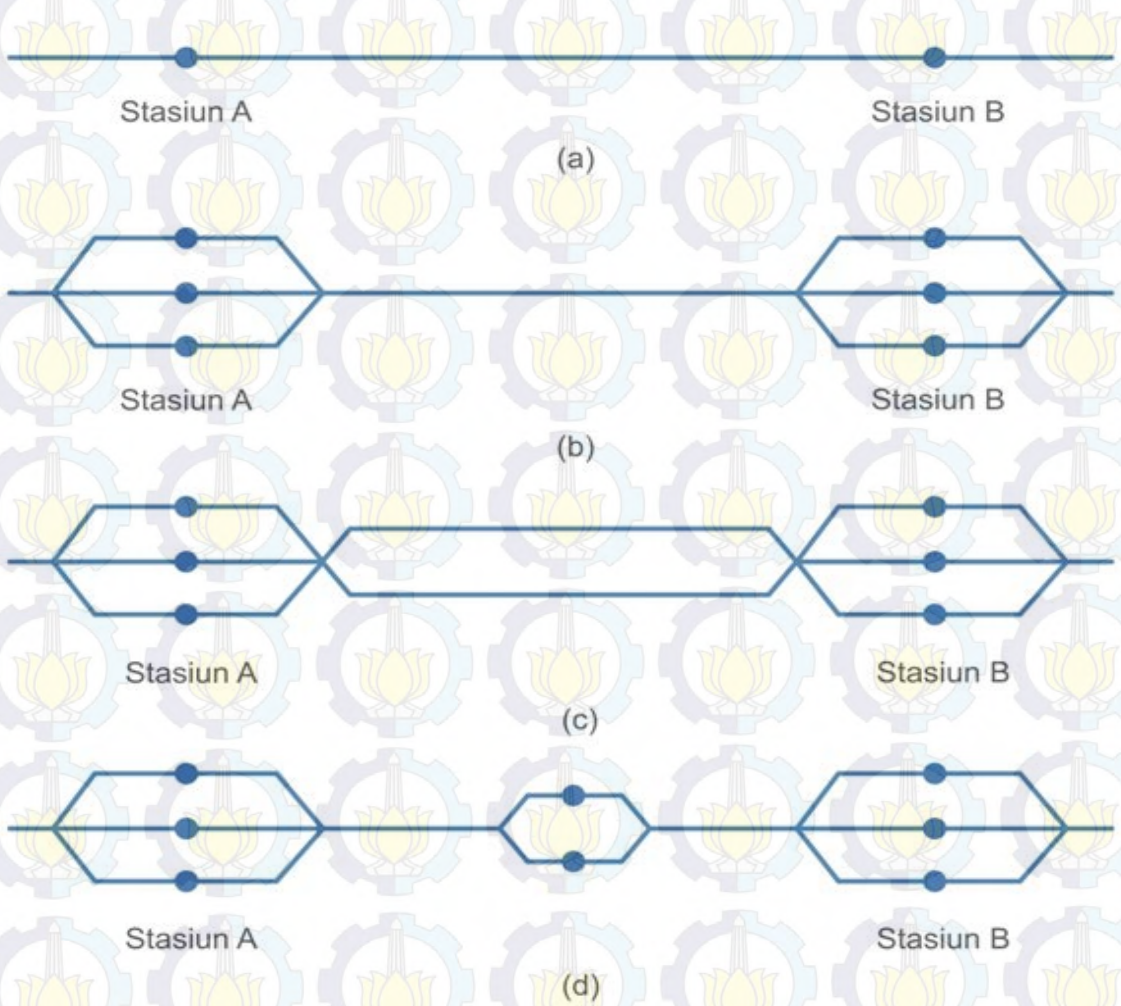
Peta Jaringan KA di Jawa

SOLUSI PERMASALAHAN

Kebijakan Pemerintah (Pembangunan Jalur Double Track)

Pengoptimalan Penggunaan Prasarana

ILUSTRASI IDE PENELITIAN



ILUSTRASI IDE PENELITIAN

Single Track

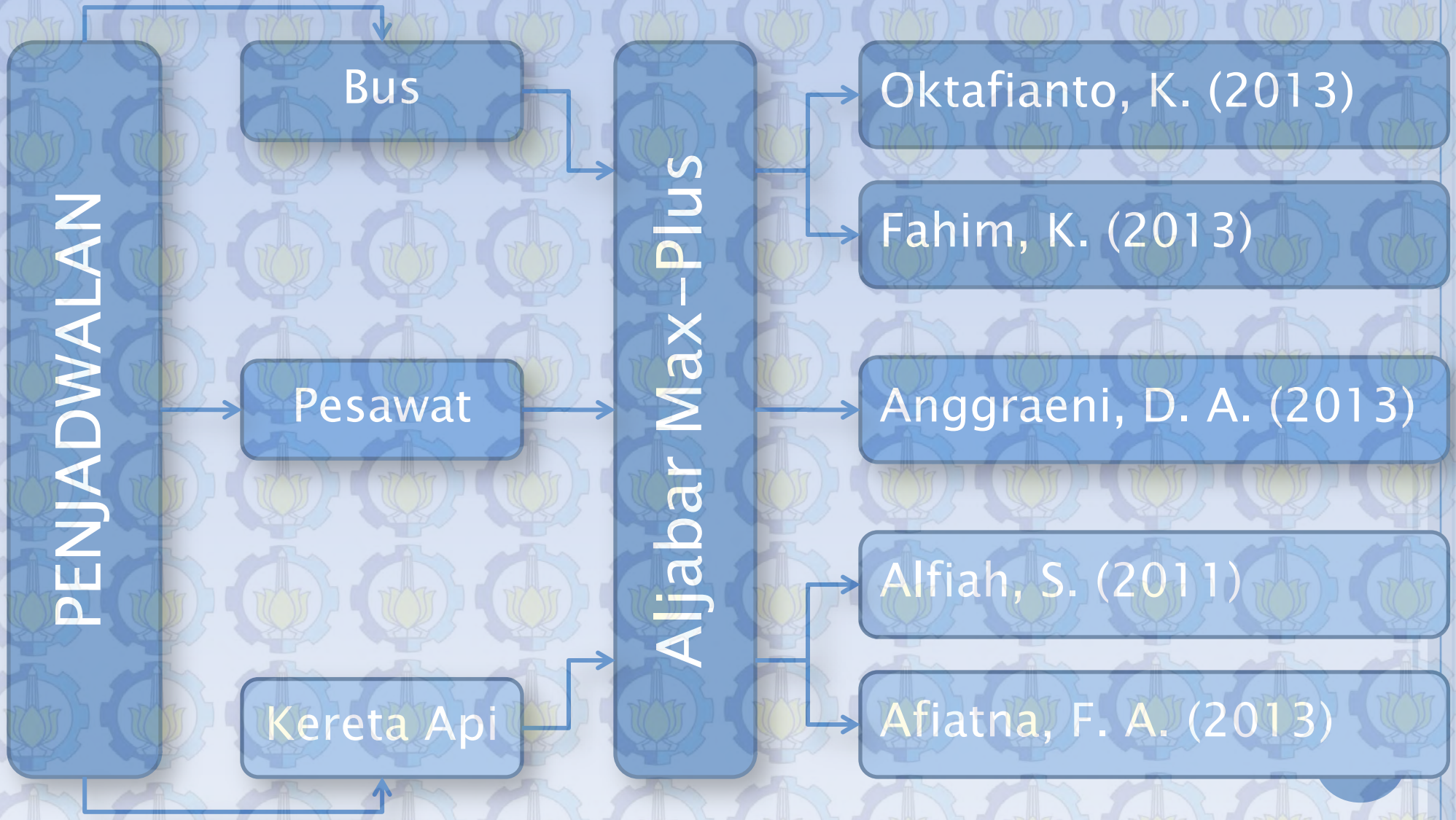
ILUSTRASI IDE PENELITIAN

Double Track

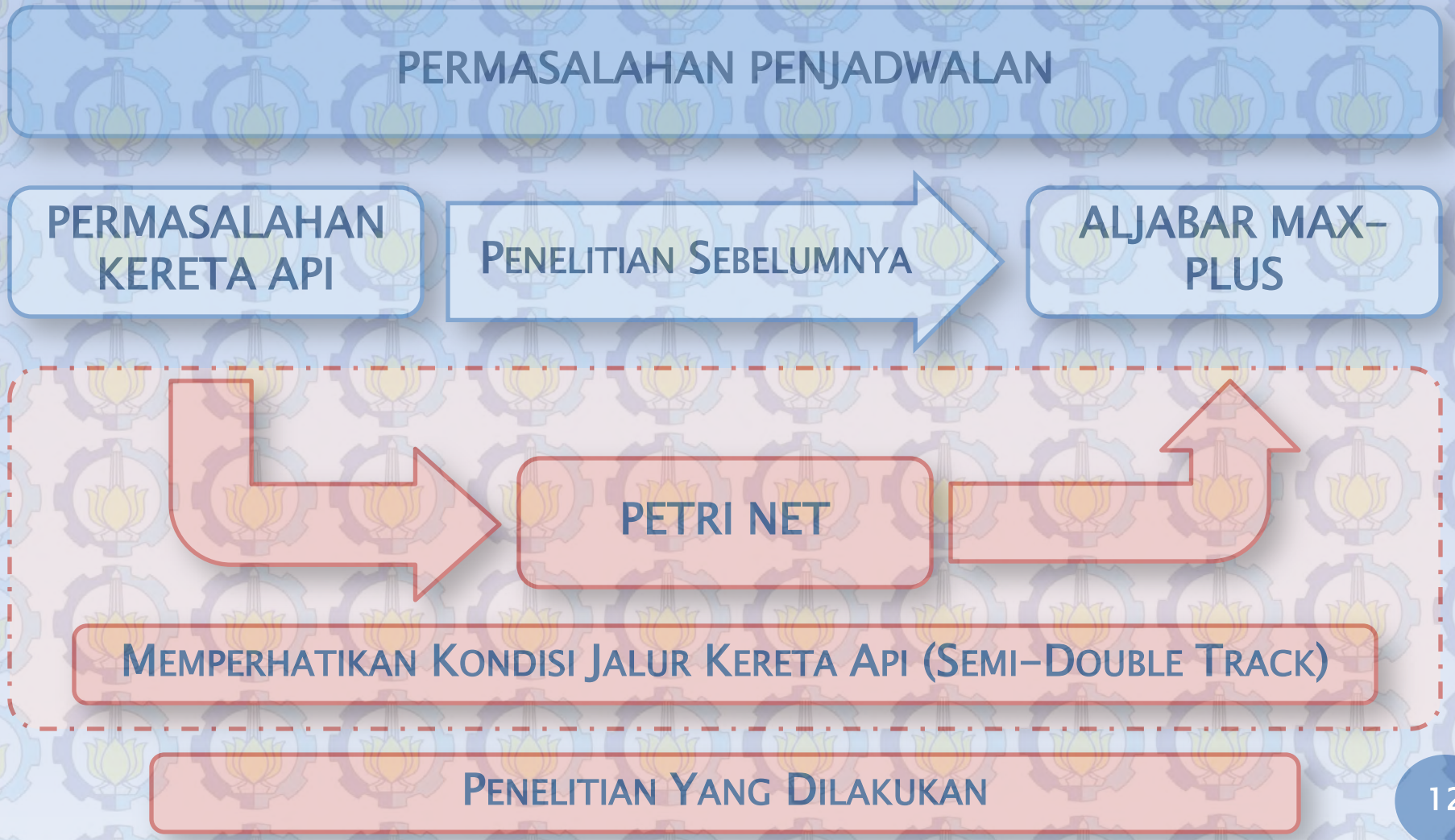
Ilustrasi Ide Penelitian

Semi-Double Track

KAJIAN PUSTAKA



Posisi Penelitian



DASAR TEORI

Secara matematis Petri Net dapat dituliskan sebagai 4-tuple (P, T, A, w) dengan:

$P = \{p_1, p_2, \dots, p_m\}$ adalah himpunan berhingga dari *places*,

$T = \{t_1, t_2, \dots, t_n\}$ adalah himpunan berhingga dari *transition*,

$A \subseteq (P \times T) \cup (T \times P)$ adalah himpunan dari garis berarah (*arcs*),

$w: A \to \{1,2,3, \dots\}$ adalah fungsi bobot pada *arcs*,

diasumsikan bahwa pada (P, T, A, w) tidak ada *place* dan *transition* yang terisolasi (Cassandras & Lafortune, 2008).

Aljabar Max-Plus adalah suatu struktur aljabar yang terdiri dari $\mathbb{R}_\epsilon$ dengan $\mathbb{R}_\epsilon = \mathbb{R} \cup \{\epsilon\}$ dan $\epsilon = -\infty$ dengan dua operator biner yaitu Operator Max ($\oplus$ "baca: *oplus*") dan Operator Plus ($\otimes$ "baca: *otimes*"), yang didefinisikan sebagai berikut, $\forall x, y \in \mathbb{R}_\epsilon$

$$x \oplus y = \max\{x, y\} \text{ dan } x \otimes y = x + y.$$

Diketahui bahwa $(\mathbb{R}_\epsilon, \oplus, \otimes)$ merupakan semiring komutatif dengan elemen netral ϵ dan elemen satuan e $(e = 0)$. Lebih lanjut lagi, $(\mathbb{R}_\epsilon, \oplus, \otimes)$ merupakan semifield idempoten (Subiono, 2015).

METODE PENELITIAN

Studi Literatur

Menentukan Aturan Hirarkis & Menyusun Model Petri Net

Menganalisis Hasil Simulasi

Menyusun Hasil Penelitian

Mengumpulkan dan Mengolah Data

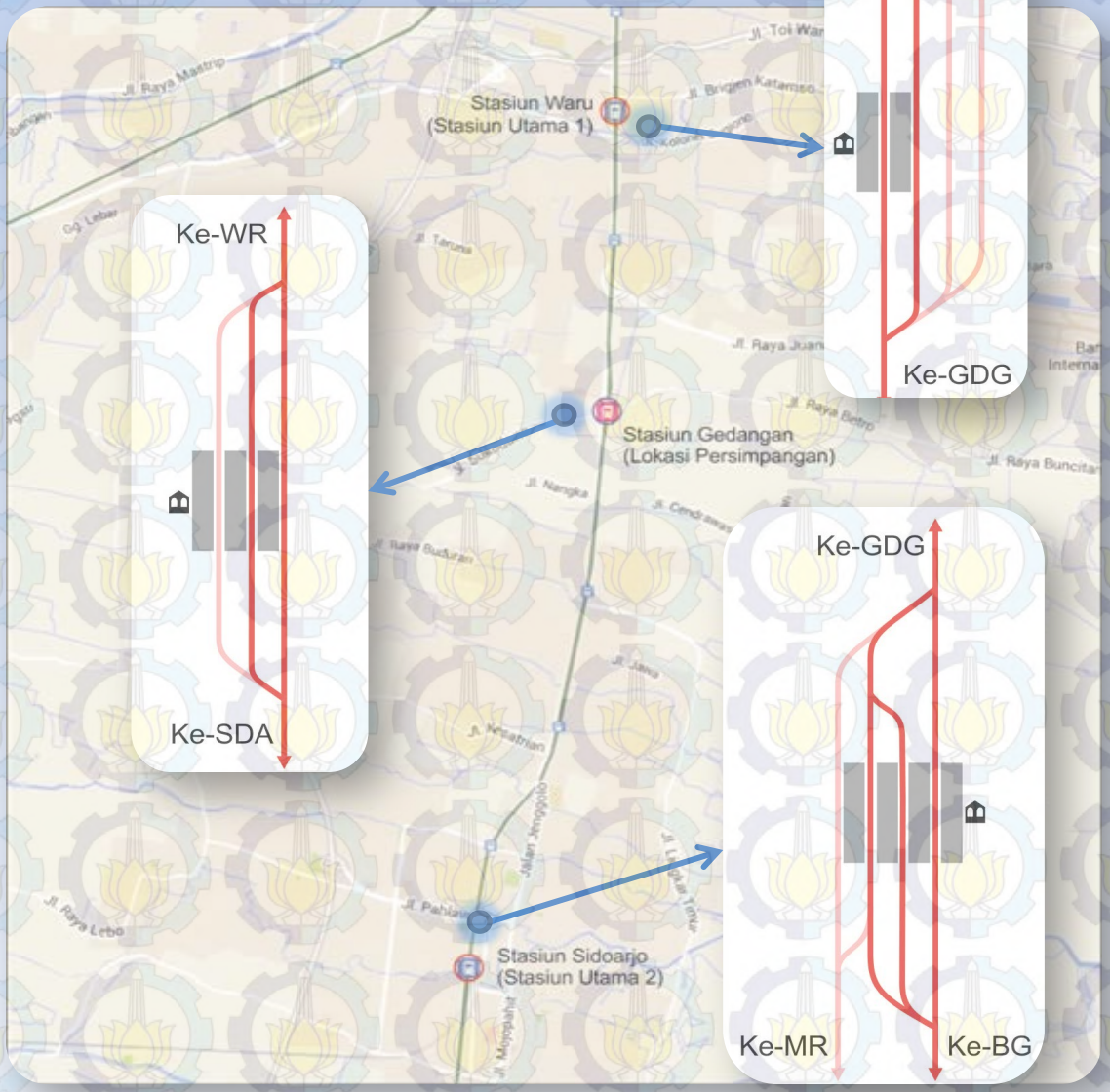
Menyusun Model Aljabar Max-Plus & Melakukan Simulasi

Hasil dan Pembahasan

Data Penelitian

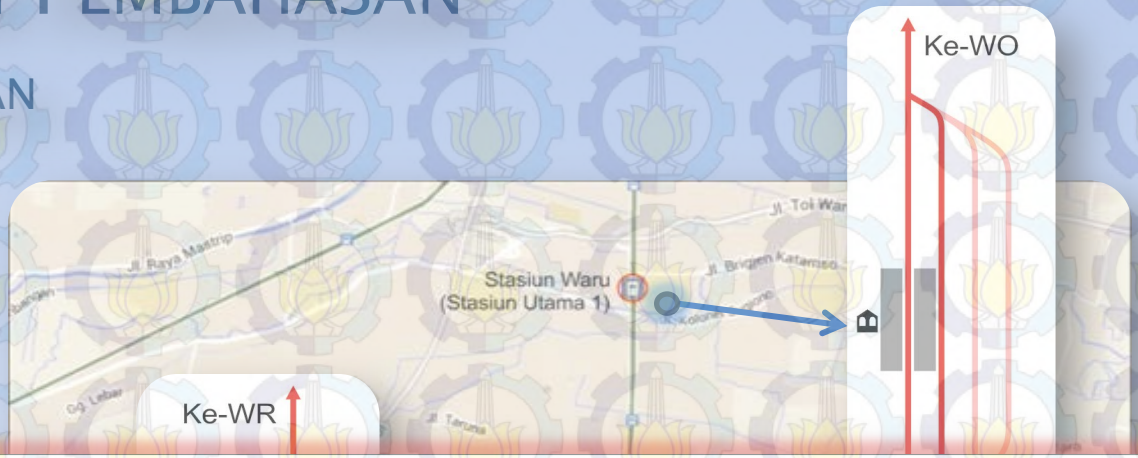
HASIL DAN PEMBAHASAN

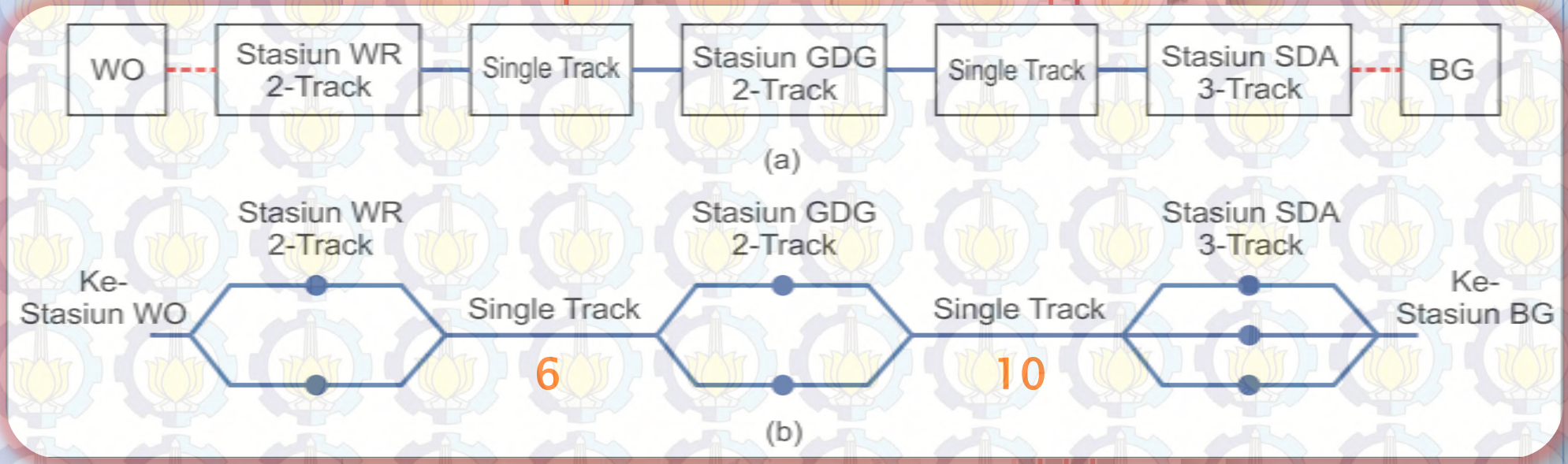
DATA PENELITIAN

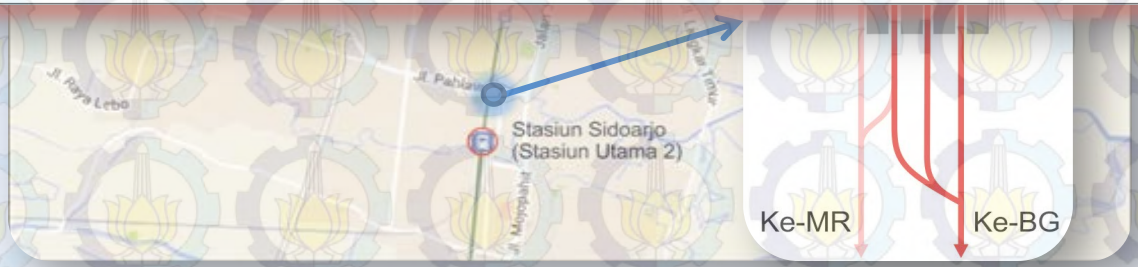


HASIL DAN PEMBAHASAN

DATA PENELITIAN

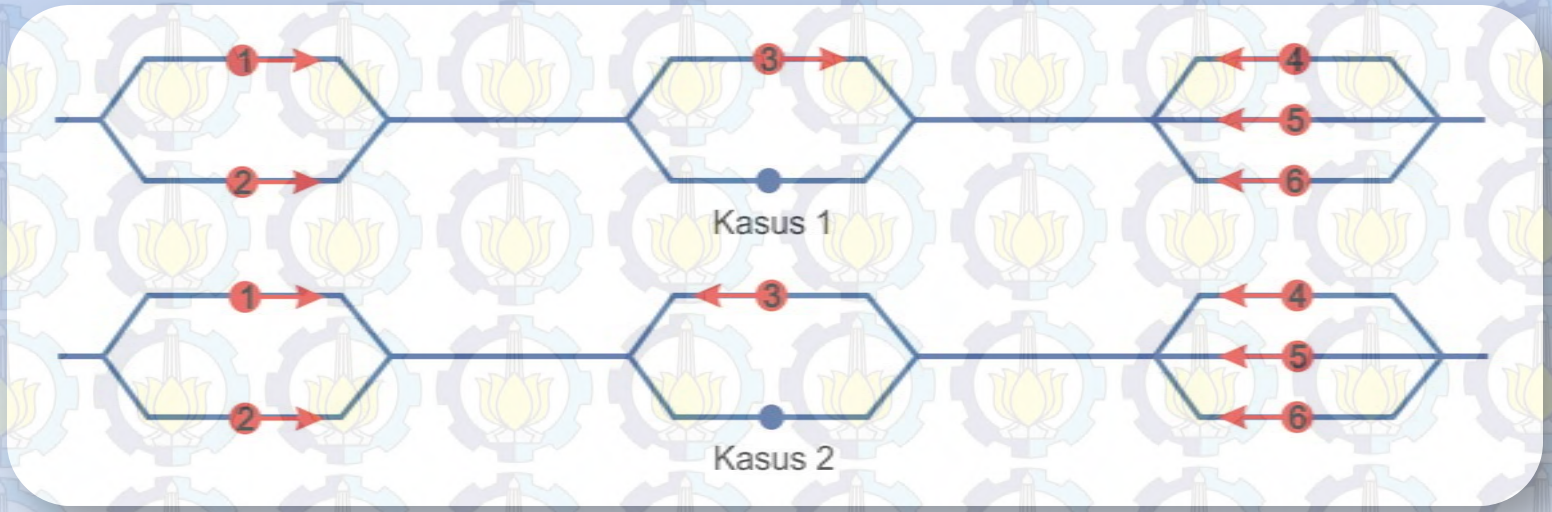






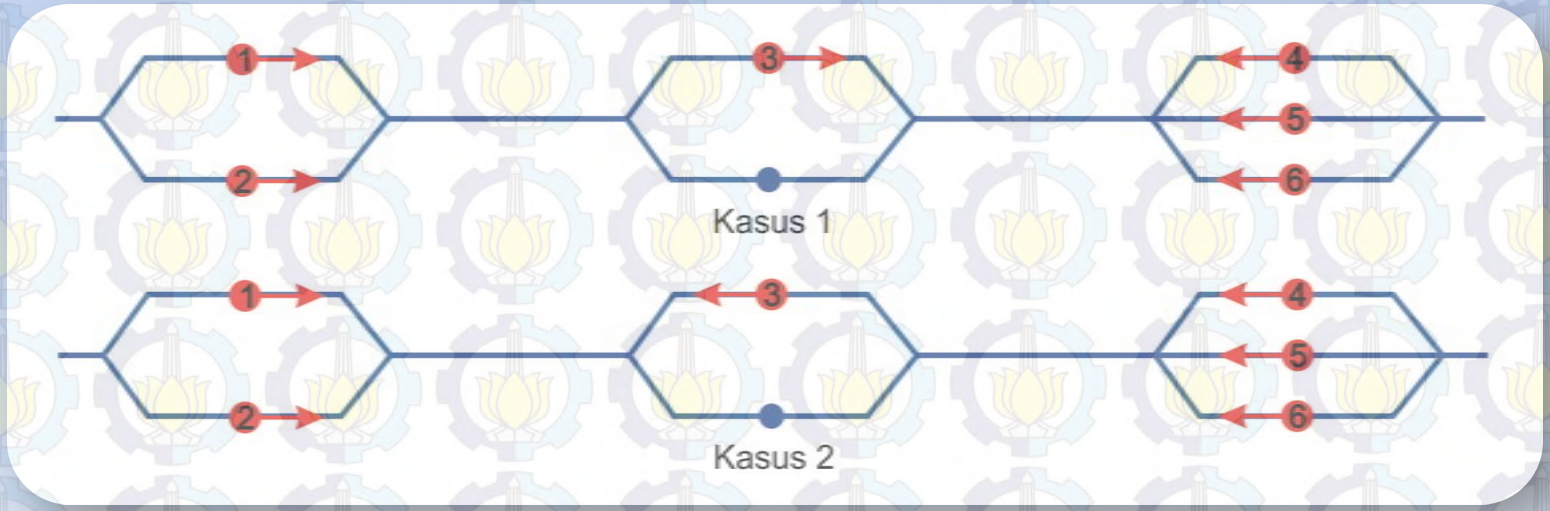
HASIL DAN PEMBAHASAN

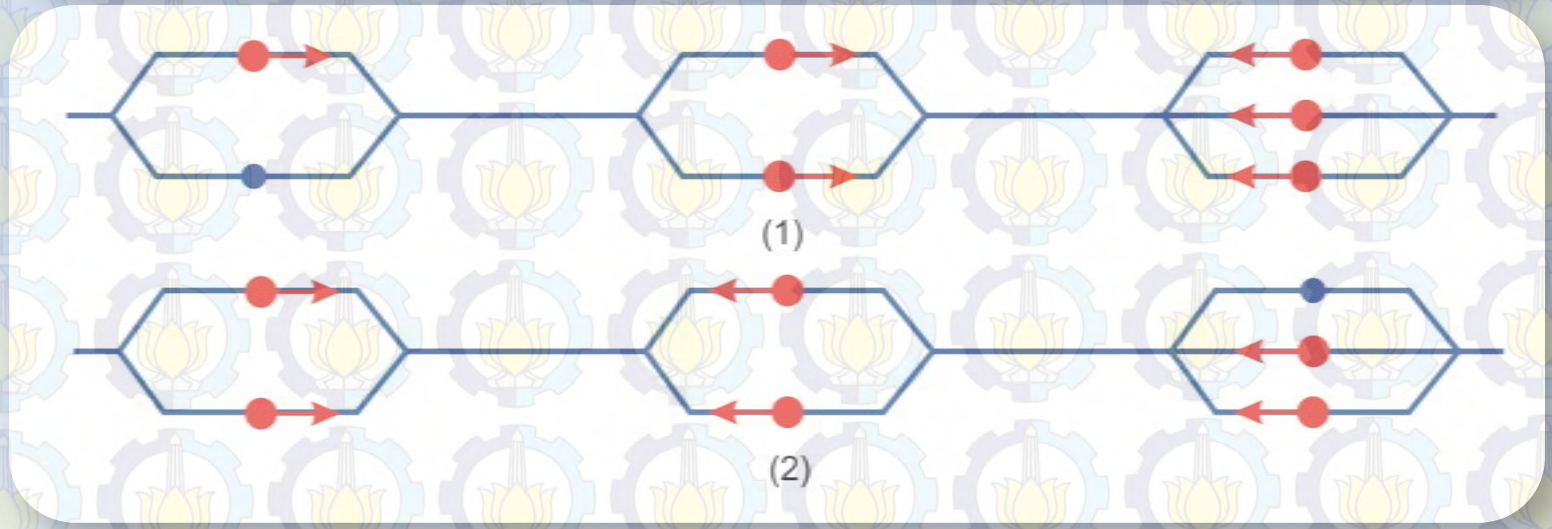
PENGANTAR PERMASALAHAN



Hasil dan Pembahasan

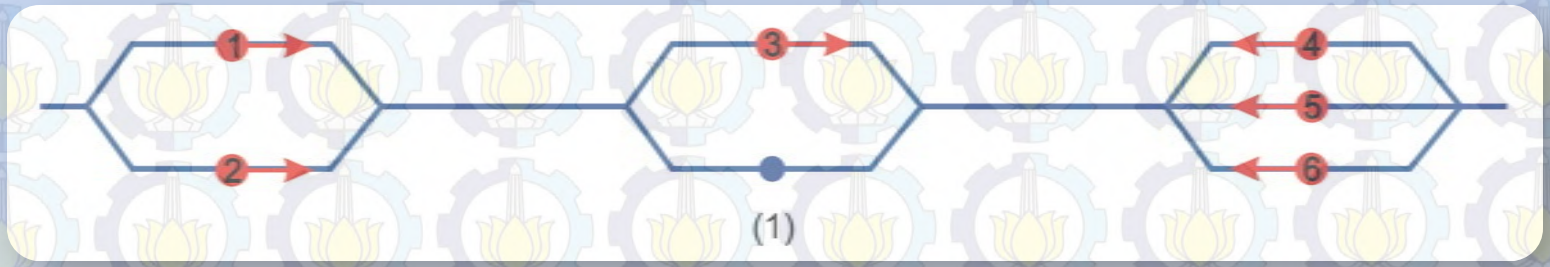
Pengantar Permasalahan





HASIL DAN PEMBAHASAN

PENGANTAR PERMASALAHAN



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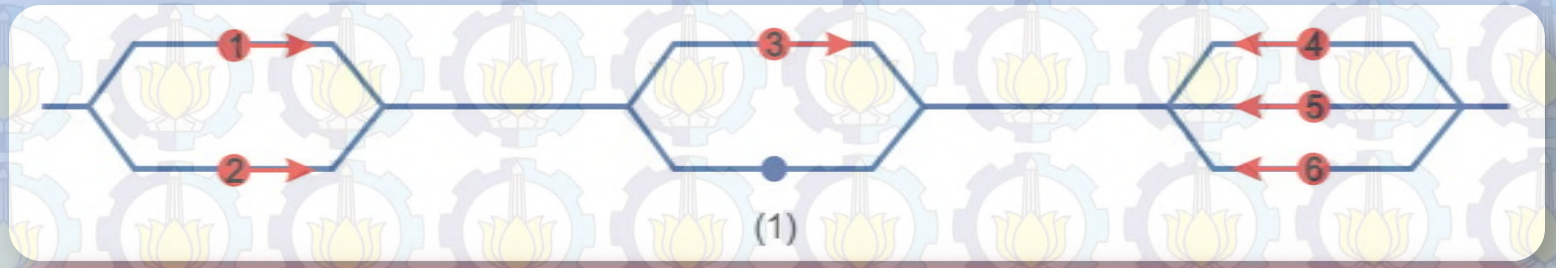
Hasil dan Pembahasan

Pengantar Permasalahan



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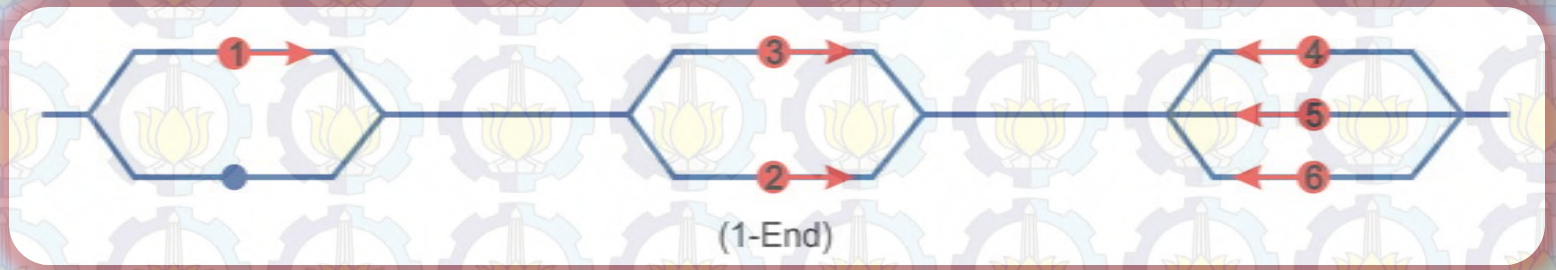

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HASIL DAN PEMBAHASAN

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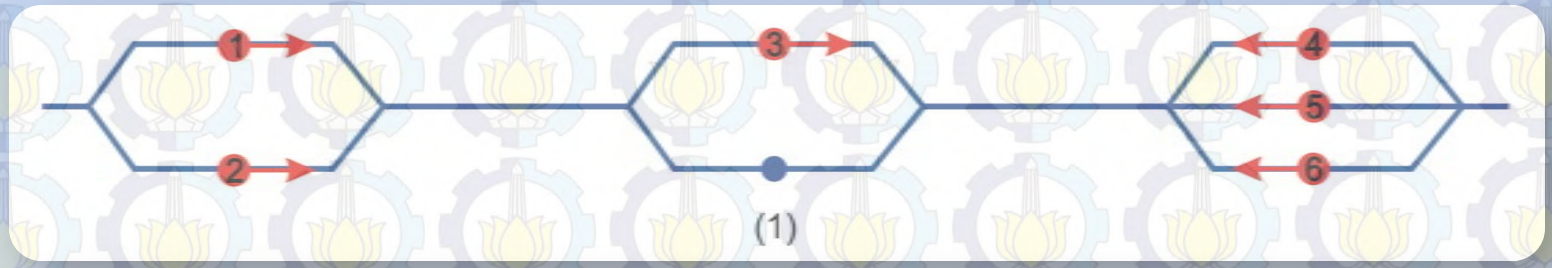

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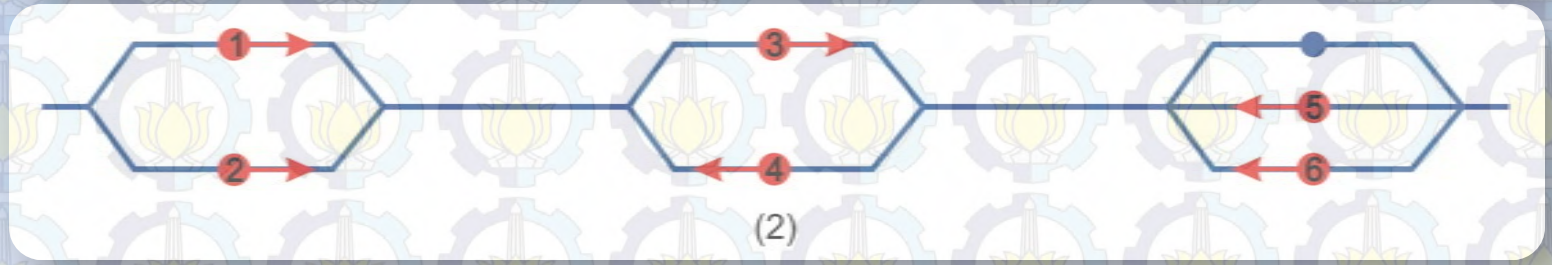

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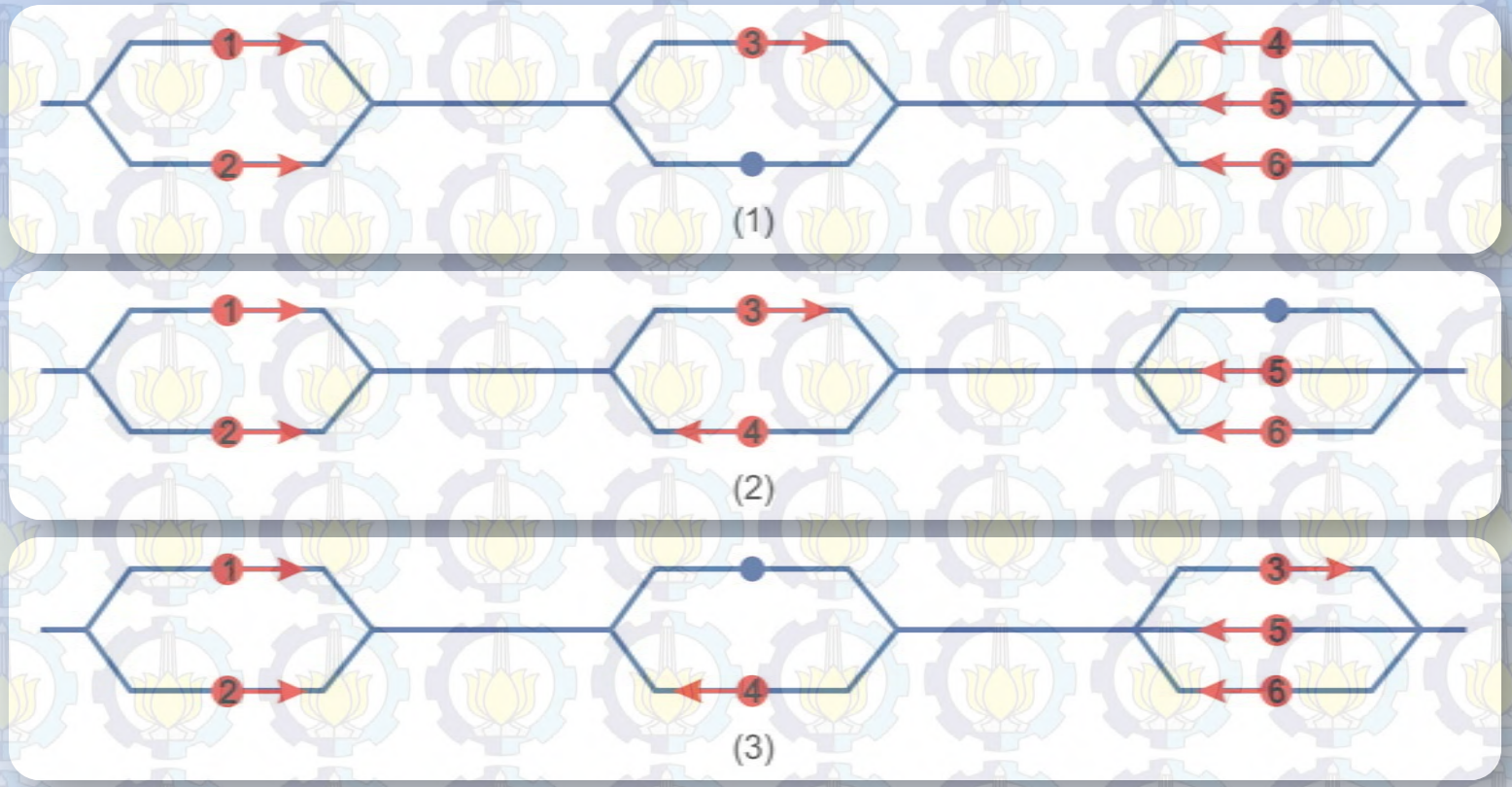

HASIL DAN PEMBAHASAN

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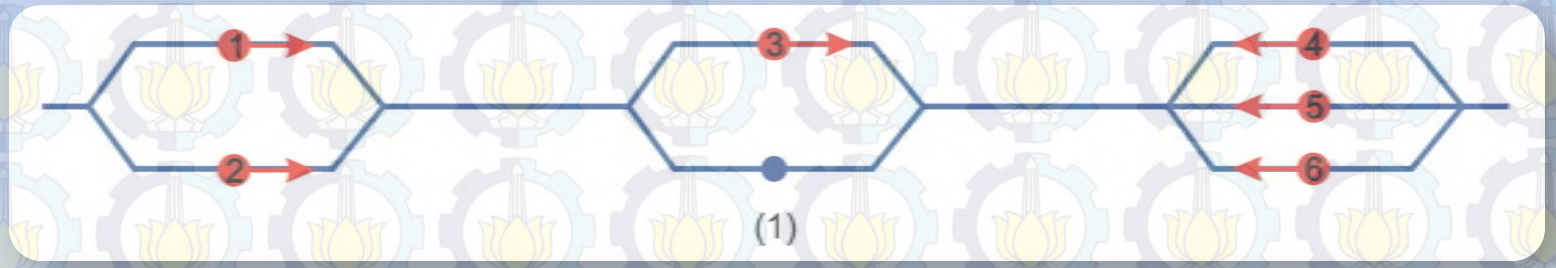

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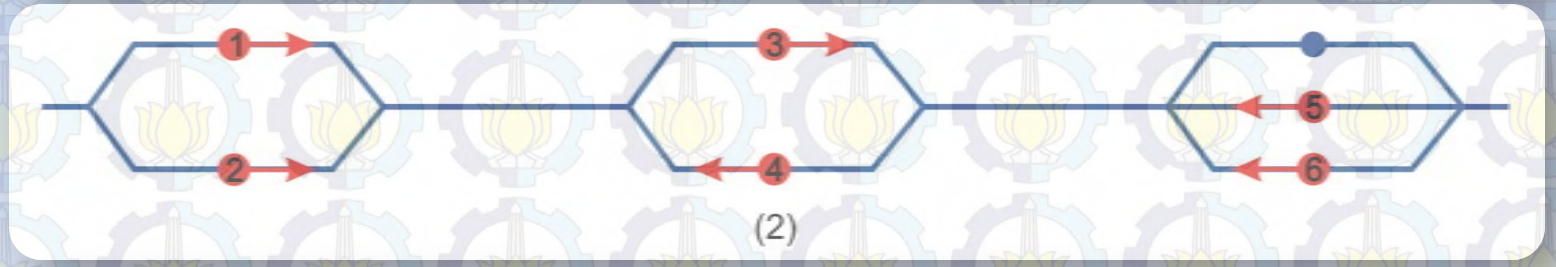

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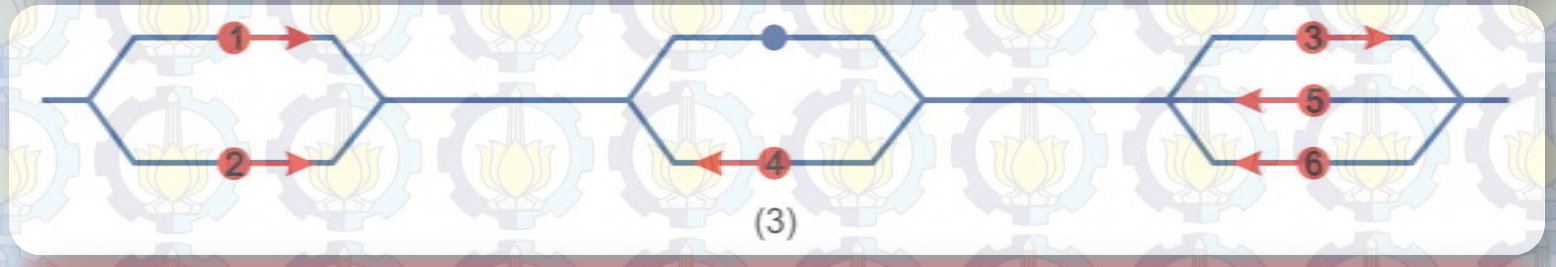

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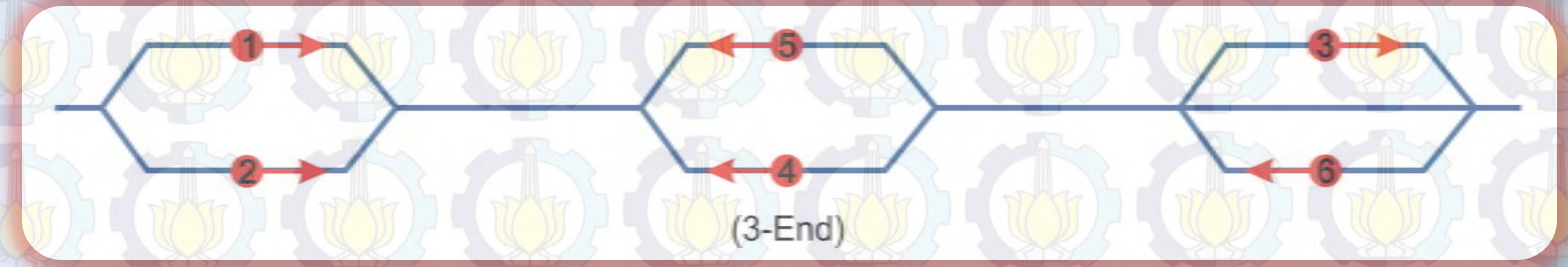

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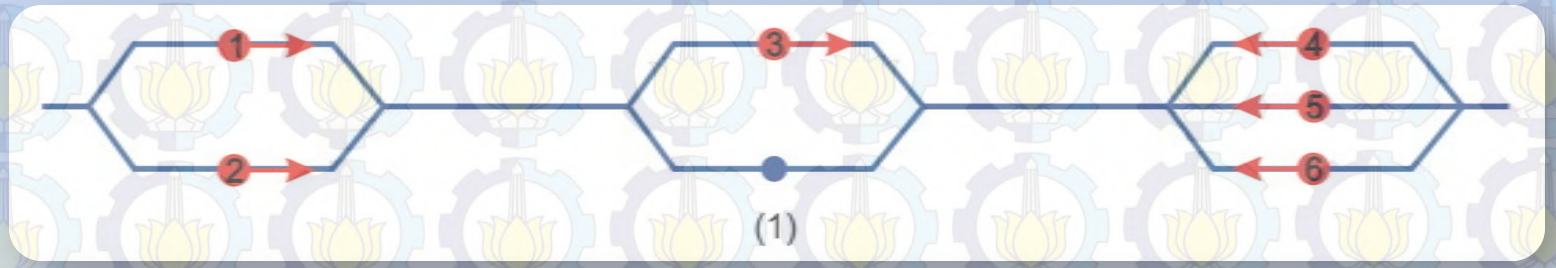
HASIL DAN PEMBAHASAN

PENGANTAR PERMASALAHAN



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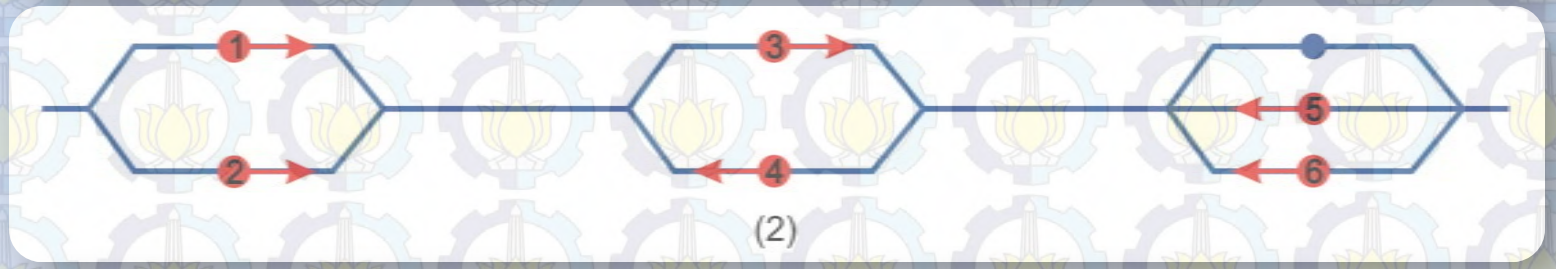

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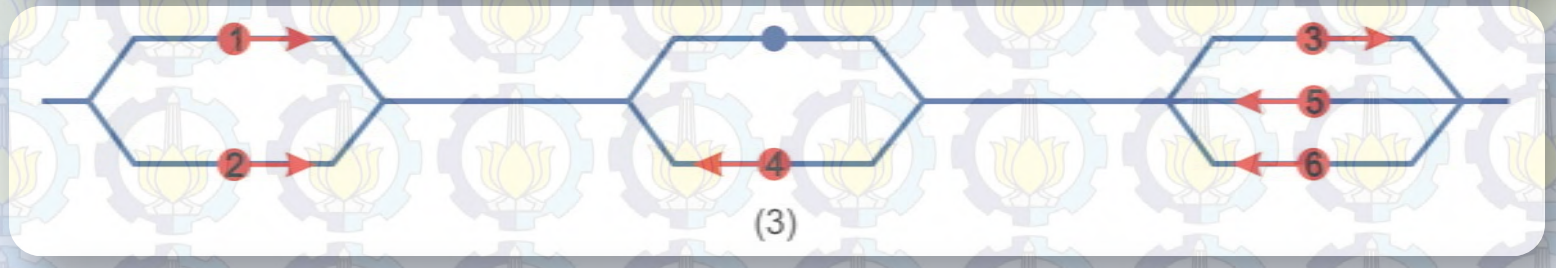

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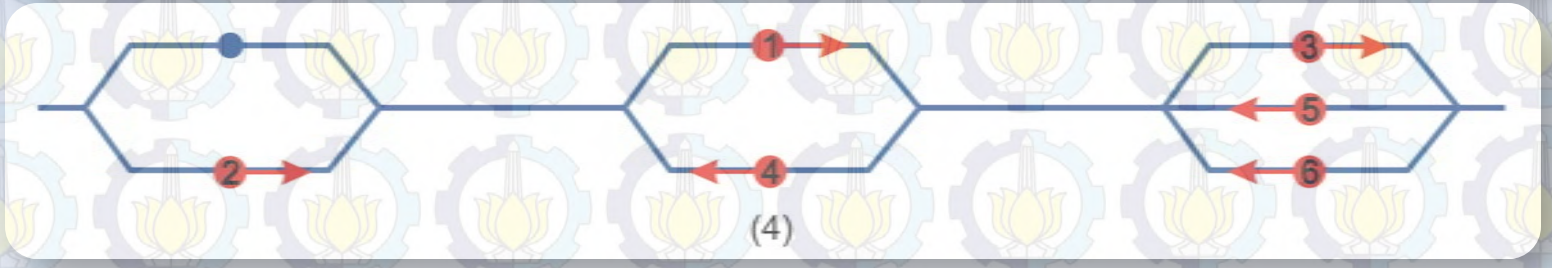

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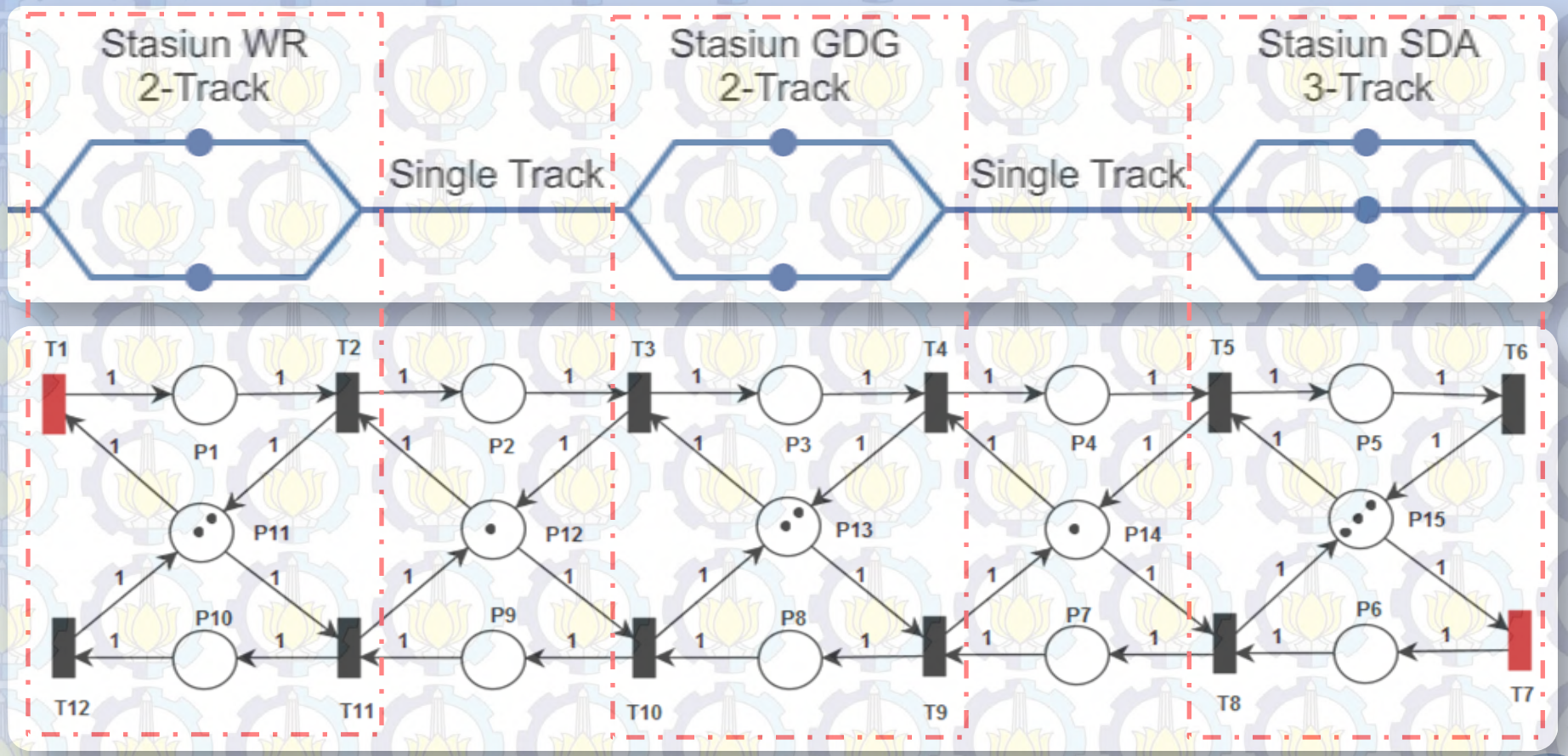
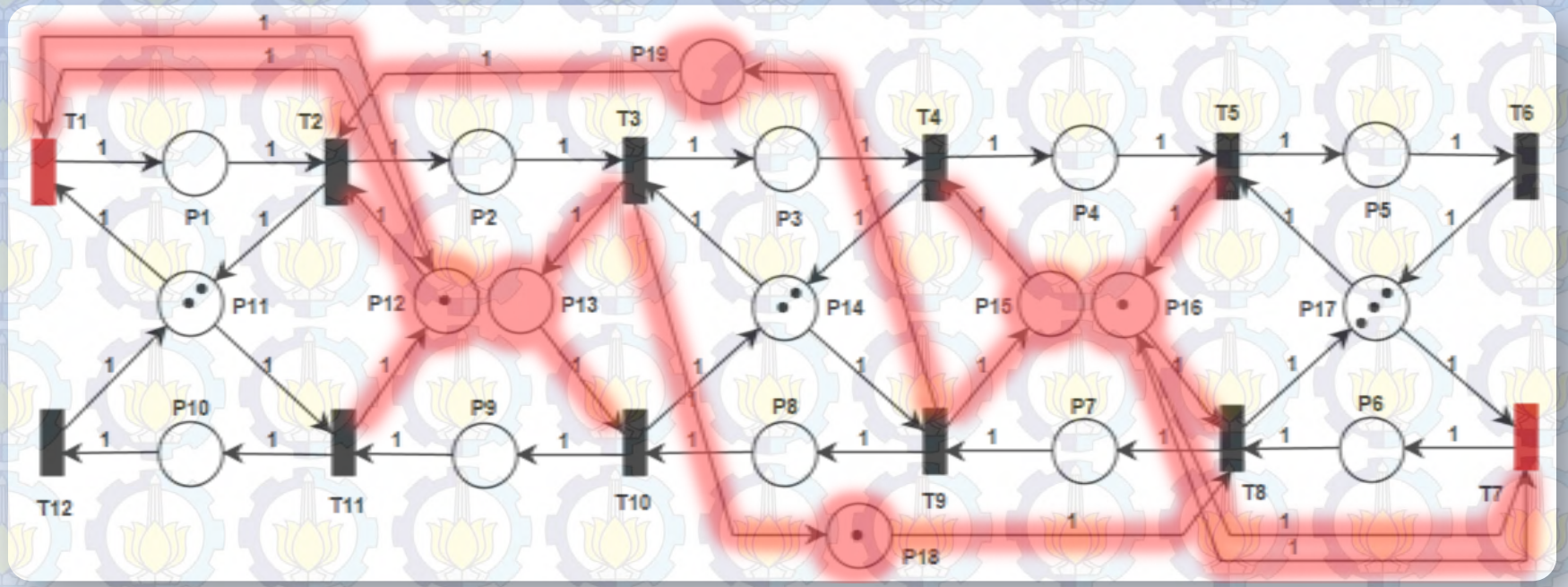
HASIL DAN PEMBAHASAN

MODEL PETRI NET TANPA PRIORITAS



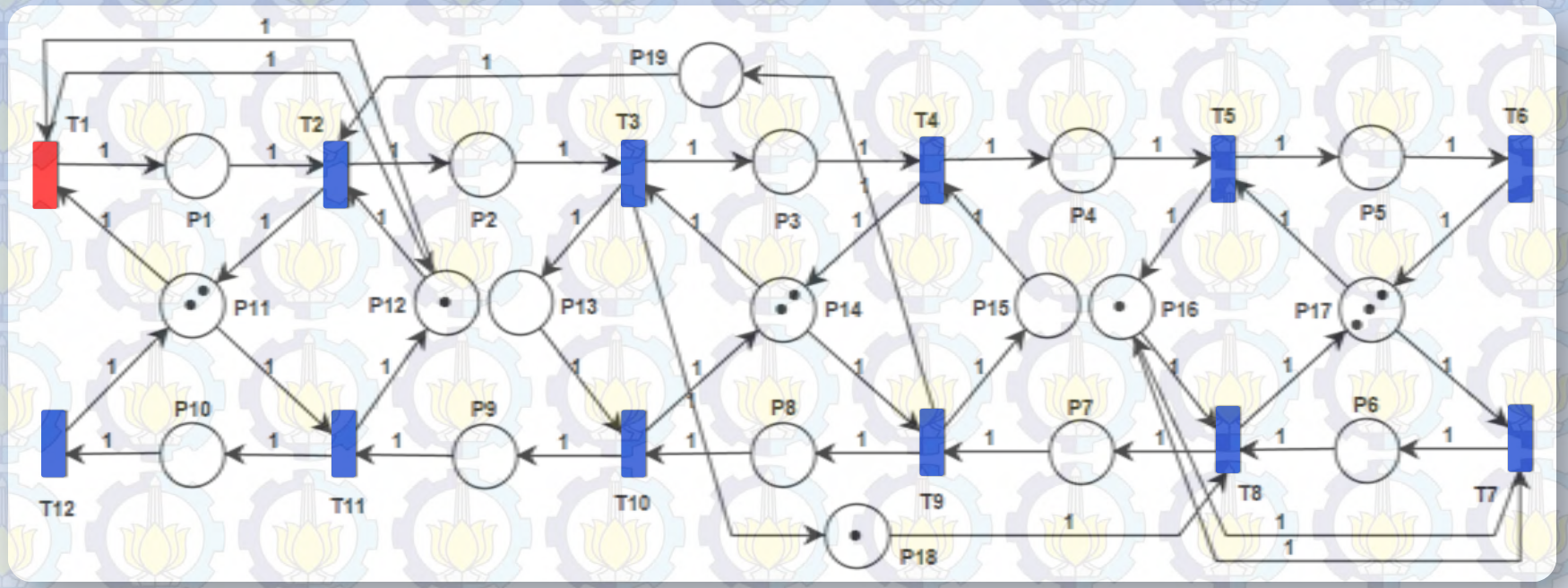
HASIL DAN PEMBAHASAN

MODEL PETRI NET DENGAN PRIORITAS



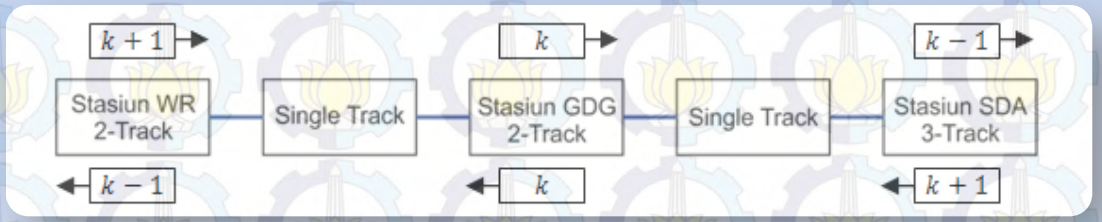
HASIL DAN PEMBAHASAN

MODEL ALJABAR MAX–PLUS



HASIL DAN PEMBAHASAN

MODEL ALJABAR MAX–PLUS



$$t_1(k+1) = [a_1 \otimes t_6(k-2)] \oplus [b \otimes t_2(k-1)] \oplus [b \otimes t_{12}(k-2)] \oplus [b \otimes t_{11}(k)]$$
$$t_2(k+1) = [a_{2,1} \otimes t_1(k+1)] \oplus [b \otimes t_9(k+1)] \oplus [b \otimes t_{11}(k)]$$
$$t_3(k+1) = [a_{3,2} \otimes t_2(k+1)] \oplus [b \otimes t_4(k-1)] \oplus [b \otimes t_{10}(k-1)]$$
$$t_4(k+1) = [a_{4,3} \otimes t_3(k+1)] \oplus [b \otimes t_9(k+1)]$$
$$t_5(k+1) = [a_{5,4} \otimes t_4(k+1)] \oplus [b \otimes t_6(k-2)] \oplus [b \otimes t_8(k-2)]$$
$$t_6(k+1) = [a_{6,5} \otimes t_5(k+1)]$$
$$t_7(k+1) = [a_7 \otimes t_{12}(k-2)] \oplus [b \otimes t_8(k-2)] \oplus [b \otimes t_6(k-3)] \oplus [b \otimes t_5(k)]$$
$$t_8(k+1) = [a_{8,7} \otimes t_7(k+1)] \oplus [b \otimes t_3(k)] \oplus [b \otimes t_5(k)]$$
$$t_9(k+1) = [a_{9,8} \otimes t_8(k+1)] \oplus [b \otimes t_4(k-1)] \oplus [b \otimes t_{10}(k-1)]$$
$$t_{10}(k+1) = [a_{10,9} \otimes t_9(k+1)] \oplus [b \otimes t_3(k+1)]$$
$$t_{11}(k+1) = [a_{11,10} \otimes t_{10}(k+1)] \oplus [b \otimes t_{12}(k-1)] \oplus [b \otimes t_2(k)]$$
$$t_{12}(k+1) = [a_{12,11} \otimes t_{11}(k+1)]$$

(1)

HASIL DAN PEMBAHASAN

MODEL ALJABAR MAX–PLUS

$$t(k+1) = [A_0 \otimes t(k+1)] \oplus [A_1 \otimes t(k)] \oplus [A_2 \otimes t(k-1)] \oplus [A_3 \otimes t(k-2)] \oplus [A_4 \otimes t(k-3)] \quad (2)$$

$$t(k+1) = [(A_0^* \otimes A_1) \otimes t(k)] \oplus [(A_0^* \otimes A_2) \otimes t(k-1)] \oplus [(A_0^* \otimes A_3) \otimes t(k-2)] \oplus [(A_0^* \otimes A_4) \otimes t(k-3)] \quad (3)$$

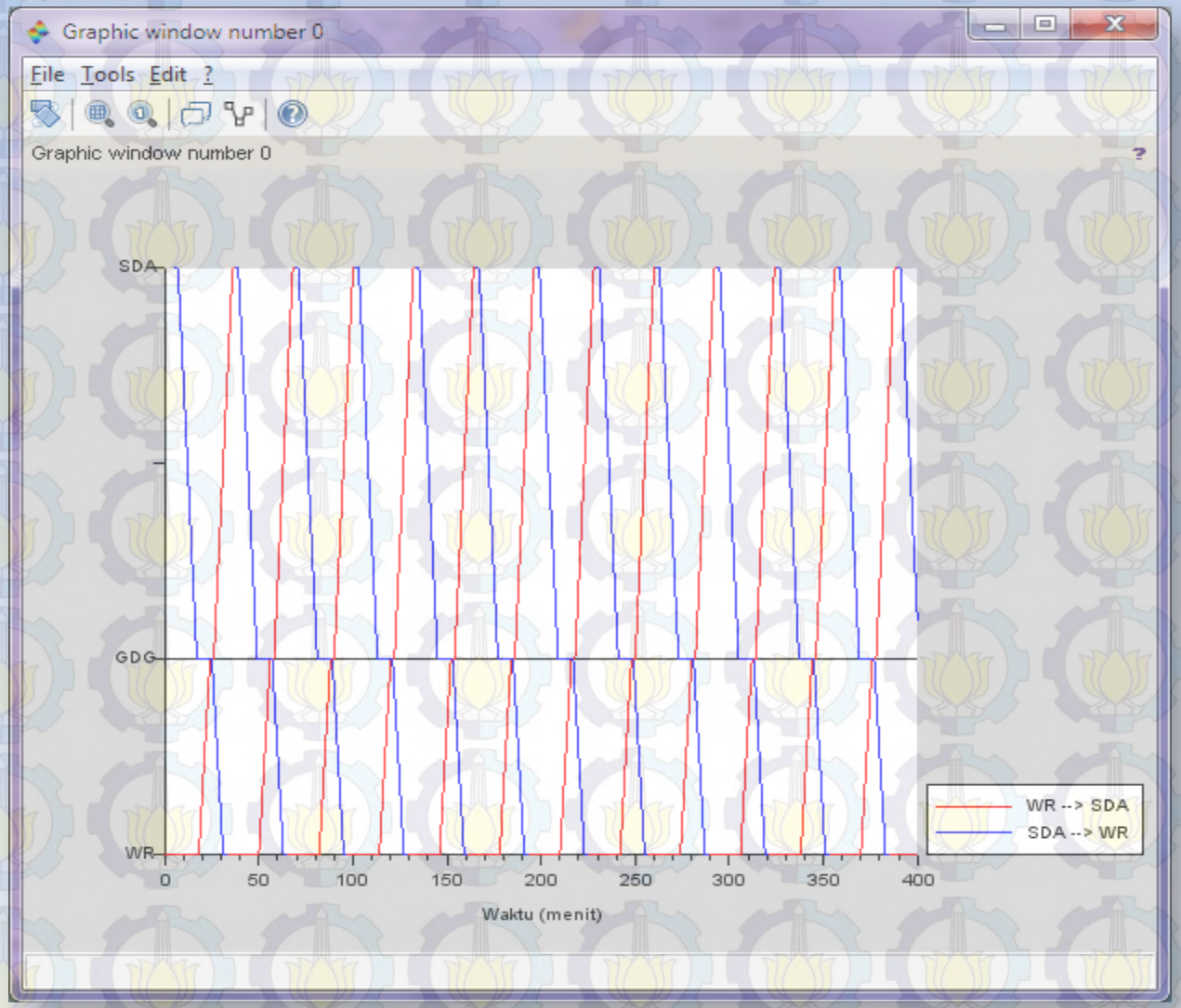
$$\tilde{t}(k+1) = \tilde{A}(k) \otimes \tilde{t}(k) \quad (4)$$

$$\tilde{A} = \begin{bmatrix} A_0^* \otimes A_1 & A_0^* \otimes A_2 & A_0^* \otimes A_3 & A_0^* \otimes A_4 \\ E & \varepsilon & \varepsilon & \varepsilon \\ \varepsilon & E & \varepsilon & \varepsilon \\ \varepsilon & \varepsilon & E & \varepsilon \end{bmatrix}$$

$$\tilde{t}(k) = [t'(k), t'(k-1), t'(k-2), t'(k-3)]'$$

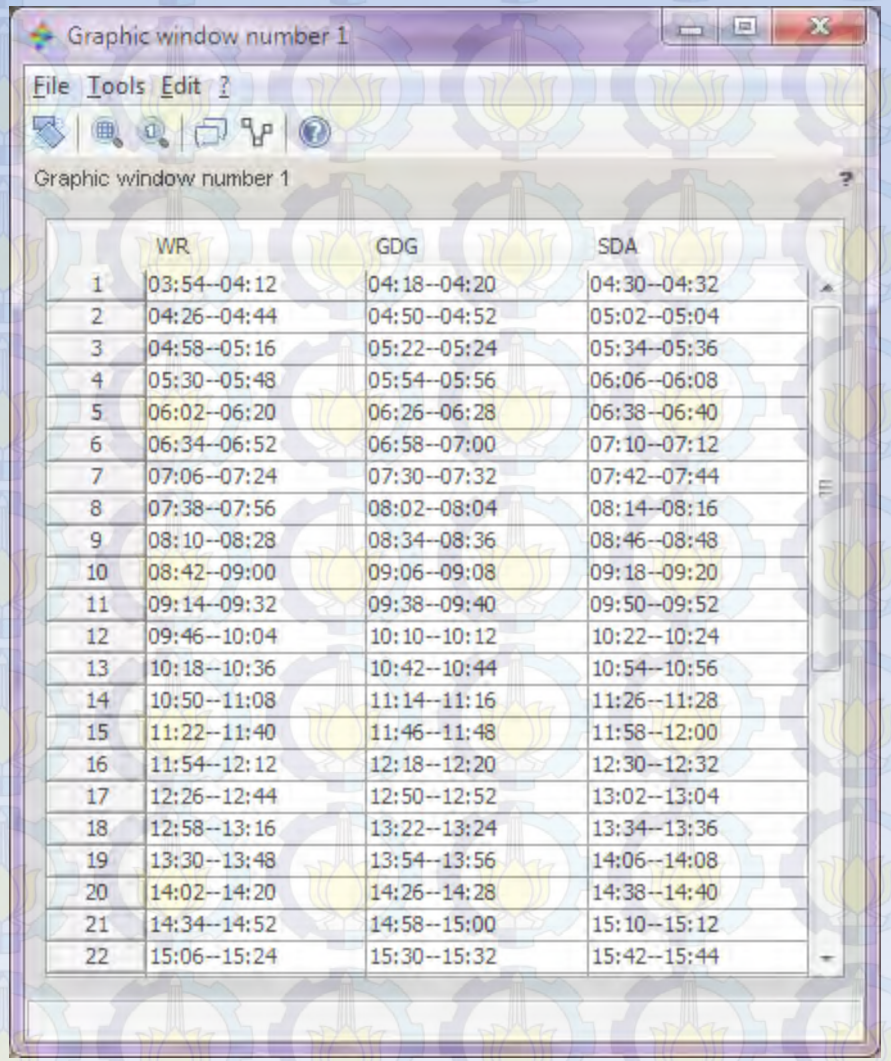
Hasil dan Pembahasan

Simulasi Model Aljabar Max-Plus

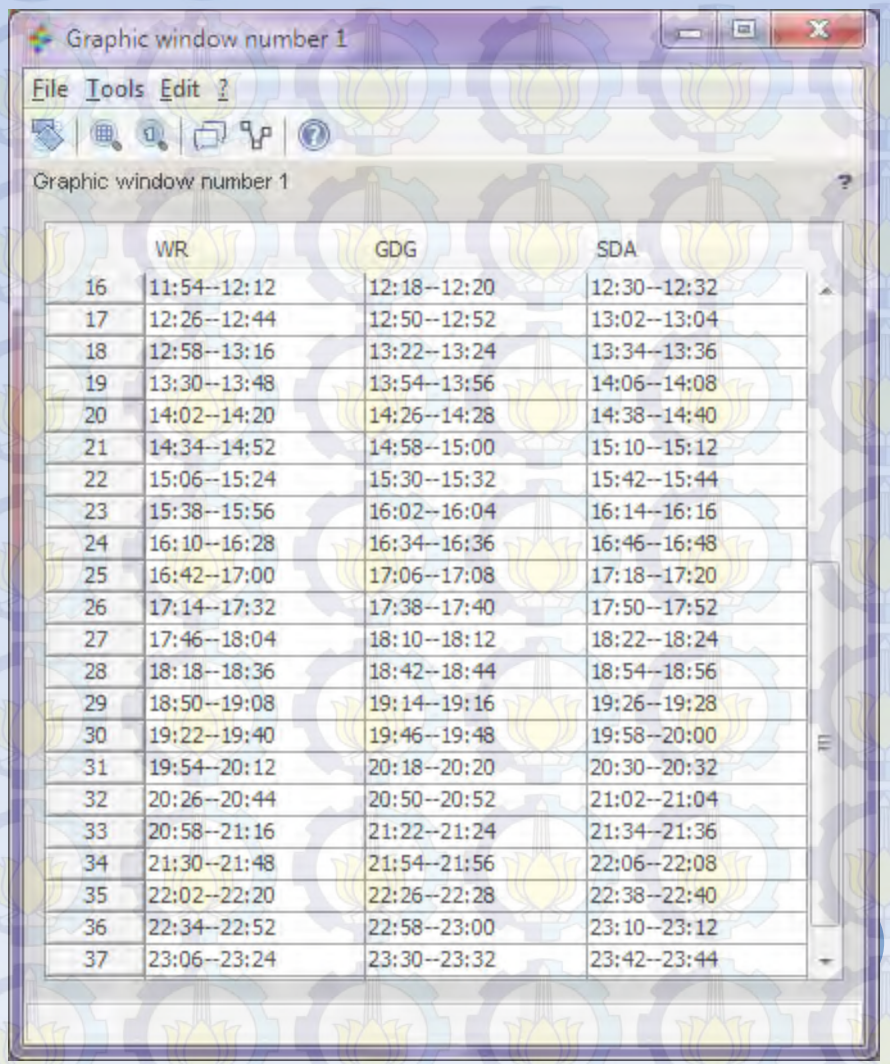


Hasil dan Pembahasan

Simulasi Model Aljabar Max–Plus



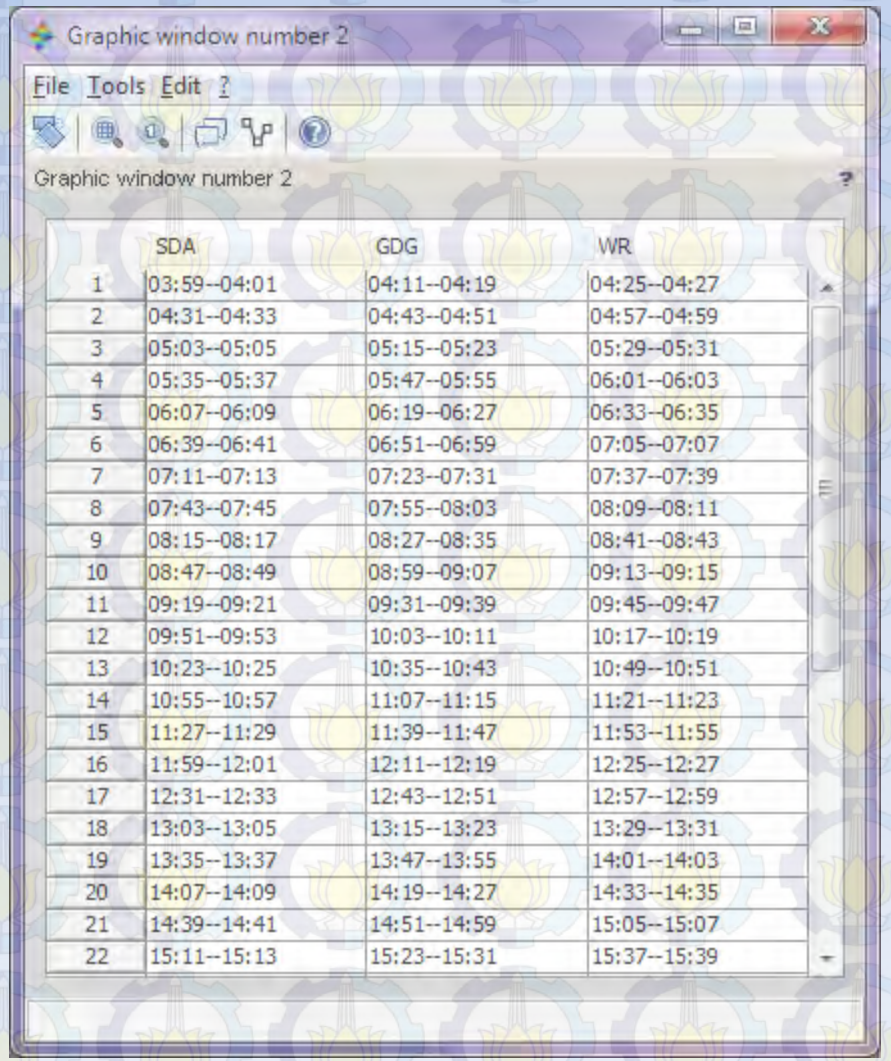
	WR	GDG	SDA
1	03:54--04:12	04:18--04:20	04:30--04:32
2	04:26--04:44	04:50--04:52	05:02--05:04
3	04:58--05:16	05:22--05:24	05:34--05:36
4	05:30--05:48	05:54--05:56	06:06--06:08
5	06:02--06:20	06:26--06:28	06:38--06:40
6	06:34--06:52	06:58--07:00	07:10--07:12
7	07:06--07:24	07:30--07:32	07:42--07:44
8	07:38--07:56	08:02--08:04	08:14--08:16
9	08:10--08:28	08:34--08:36	08:46--08:48
10	08:42--09:00	09:06--09:08	09:18--09:20
11	09:14--09:32	09:38--09:40	09:50--09:52
12	09:46--10:04	10:10--10:12	10:22--10:24
13	10:18--10:36	10:42--10:44	10:54--10:56
14	10:50--11:08	11:14--11:16	11:26--11:28
15	11:22--11:40	11:46--11:48	11:58--12:00
16	11:54--12:12	12:18--12:20	12:30--12:32
17	12:26--12:44	12:50--12:52	13:02--13:04
18	12:58--13:16	13:22--13:24	13:34--13:36
19	13:30--13:48	13:54--13:56	14:06--14:08
20	14:02--14:20	14:26--14:28	14:38--14:40
21	14:34--14:52	14:58--15:00	15:10--15:12
22	15:06--15:24	15:30--15:32	15:42--15:44



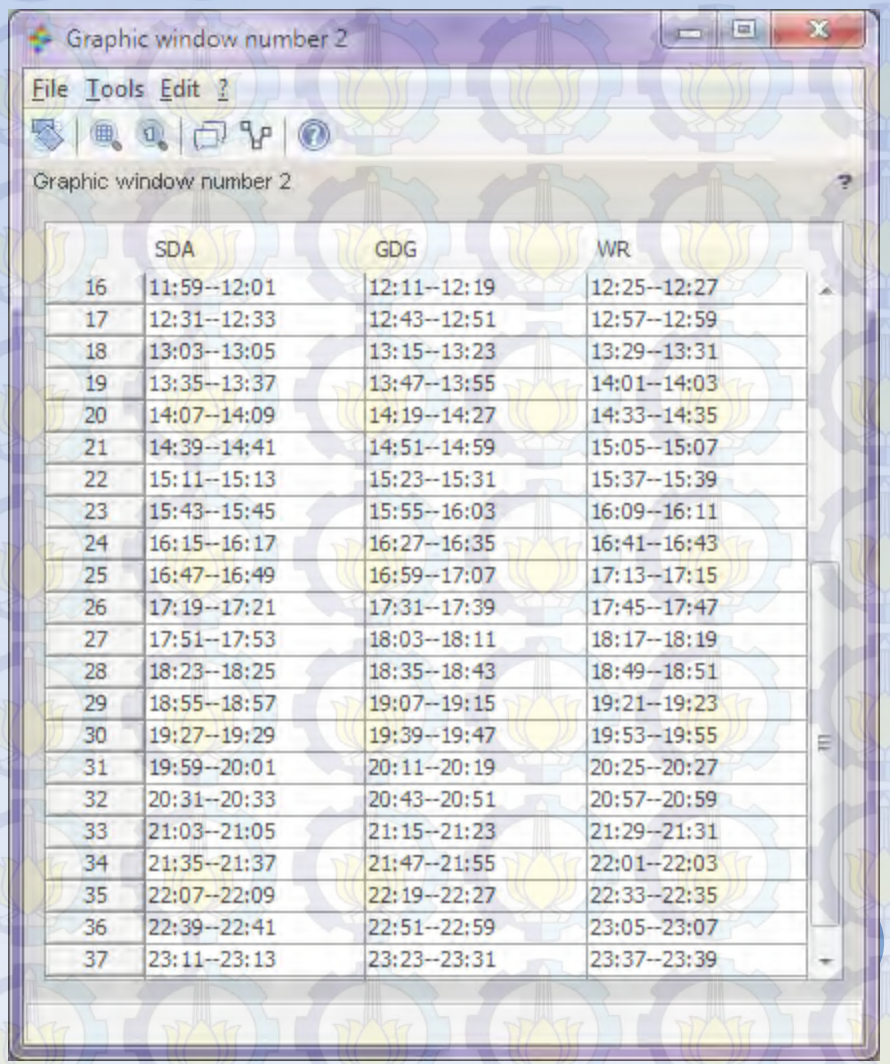
	WR	GDG	SDA
16	11:54--12:12	12:18--12:20	12:30--12:32
17	12:26--12:44	12:50--12:52	13:02--13:04
18	12:58--13:16	13:22--13:24	13:34--13:36
19	13:30--13:48	13:54--13:56	14:06--14:08
20	14:02--14:20	14:26--14:28	14:38--14:40
21	14:34--14:52	14:58--15:00	15:10--15:12
22	15:06--15:24	15:30--15:32	15:42--15:44
23	15:38--15:56	16:02--16:04	16:14--16:16
24	16:10--16:28	16:34--16:36	16:46--16:48
25	16:42--17:00	17:06--17:08	17:18--17:20
26	17:14--17:32	17:38--17:40	17:50--17:52
27	17:46--18:04	18:10--18:12	18:22--18:24
28	18:18--18:36	18:42--18:44	18:54--18:56
29	18:50--19:08	19:14--19:16	19:26--19:28
30	19:22--19:40	19:46--19:48	19:58--20:00
31	19:54--20:12	20:18--20:20	20:30--20:32
32	20:26--20:44	20:50--20:52	21:02--21:04
33	20:58--21:16	21:22--21:24	21:34--21:36
34	21:30--21:48	21:54--21:56	22:06--22:08
35	22:02--22:20	22:26--22:28	22:38--22:40
36	22:34--22:52	22:58--23:00	23:10--23:12
37	23:06--23:24	23:30--23:32	23:42--23:44

Hasil dan Pembahasan

Simulasi Model Aljabar Max–Plus



	SDA	GDG	WR
1	03:59--04:01	04:11--04:19	04:25--04:27
2	04:31--04:33	04:43--04:51	04:57--04:59
3	05:03--05:05	05:15--05:23	05:29--05:31
4	05:35--05:37	05:47--05:55	06:01--06:03
5	06:07--06:09	06:19--06:27	06:33--06:35
6	06:39--06:41	06:51--06:59	07:05--07:07
7	07:11--07:13	07:23--07:31	07:37--07:39
8	07:43--07:45	07:55--08:03	08:09--08:11
9	08:15--08:17	08:27--08:35	08:41--08:43
10	08:47--08:49	08:59--09:07	09:13--09:15
11	09:19--09:21	09:31--09:39	09:45--09:47
12	09:51--09:53	10:03--10:11	10:17--10:19
13	10:23--10:25	10:35--10:43	10:49--10:51
14	10:55--10:57	11:07--11:15	11:21--11:23
15	11:27--11:29	11:39--11:47	11:53--11:55
16	11:59--12:01	12:11--12:19	12:25--12:27
17	12:31--12:33	12:43--12:51	12:57--12:59
18	13:03--13:05	13:15--13:23	13:29--13:31
19	13:35--13:37	13:47--13:55	14:01--14:03
20	14:07--14:09	14:19--14:27	14:33--14:35
21	14:39--14:41	14:51--14:59	15:05--15:07
22	15:11--15:13	15:23--15:31	15:37--15:39



	SDA	GDG	WR
16	11:59--12:01	12:11--12:19	12:25--12:27
17	12:31--12:33	12:43--12:51	12:57--12:59
18	13:03--13:05	13:15--13:23	13:29--13:31
19	13:35--13:37	13:47--13:55	14:01--14:03
20	14:07--14:09	14:19--14:27	14:33--14:35
21	14:39--14:41	14:51--14:59	15:05--15:07
22	15:11--15:13	15:23--15:31	15:37--15:39
23	15:43--15:45	15:55--16:03	16:09--16:11
24	16:15--16:17	16:27--16:35	16:41--16:43
25	16:47--16:49	16:59--17:07	17:13--17:15
26	17:19--17:21	17:31--17:39	17:45--17:47
27	17:51--17:53	18:03--18:11	18:17--18:19
28	18:23--18:25	18:35--18:43	18:49--18:51
29	18:55--18:57	19:07--19:15	19:21--19:23
30	19:27--19:29	19:39--19:47	19:53--19:55
31	19:59--20:01	20:11--20:19	20:25--20:27
32	20:31--20:33	20:43--20:51	20:57--20:59
33	21:03--21:05	21:15--21:23	21:29--21:31
34	21:35--21:37	21:47--21:55	22:01--22:03
35	22:07--22:09	22:19--22:27	22:33--22:35
36	22:39--22:41	22:51--22:59	23:05--23:07
37	23:11--23:13	23:23--23:31	23:37--23:39

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TERIMA KASIH ATAS PERHATIANNYA